A1 cont'd.

portion. Such a field emission device comprises a cathode electrode 211 formed on a support member 210, an insulating layer 212 formed on the support member 210 and the cathode electrode 211, a gate electrode 213 formed on the insulating layer 212, an opening portion 214 formed in the gate electrode 213 and the insulating layer 212, and a conical electron emitting portion 215 formed on the cathode electrode 211 positioned in a bottom of the opening portion 214. Generally, the cathode electrode 211 and the gate electrode 213 are formed in the form of a stripe each in directions in which projection images of these two electrodes cross each other at right angles. Generally, a plurality of field emission devices are arranged in a region (corresponding to one pixel, the region will be called an "overlapped region" hereinafter) where the projection images of the above two electrodes overlap. Further, generally, such overlapped regions are arranged in the form of a matrix within an effective field (which works as an actual display portion) of a cathode panel CP.

Beginning on page 4, line 15:

A2

The outline of the method of manufacturing the conventional Spindt-type electron emission device will be explained hereinafter. In principle, this method is a method of forming the conical electron emitting electrode 215 by vertical deposition of a metal material. That is, vaporized particles perpendicularly enter the opening portion 214. The amount of the vaporized particles which reach the bottom of the opening portion 214 is gradually decreased by utilizing the shielding effect of an overhanging deposit formed around the opening portion 214, so that the electron emitting electrode 215 as a conical deposit is formed in a self-aligned manner. This embodiment employs a method of pre-forming a ~~pee~~peel-off layer 217 on the gate electrode 213 for easing the removal of the unnecessary overhanging deposit, and the method will be explained below with reference Figs. 22A, 22B, 22C, 23A and 23B which are schematic partial end ~~vies~~ views of a support member, etc.

Beginning on page 5, line 8:

A3

Then, a resist layer 216 which works as an etching mask is formed on the insulating layer 212 and the gate electrode 213 by lithography (see Fig. 22A). Then, a first opening portion 214A

is formed in the gate electrode 213 by RIE (reactive ion etching) method and a second opening portion 214B communicating with the first opening portion 214A is formed in the insulating layer 212. The~~se~~ first opening portion 214A and second opening portion 214B will be sometimes generically referred to as "opening portion 214" hereinafter. The cathode electrode 211 is exposed in a bottom of the opening portion 214. Then, the resist layer 216 is removed by an ashing method, whereby the structure shown in Fig. 22B can be obtained.

K3 cont.

Beginning on page 6, line 1:

Then, for example, molybdenum (Mo) is vertically vapor-deposited on the entire surface. In this case, as an electric conductive material layer 218 made of molybdenum having an overhanging form grows on the peel-off layer 217, the substantial diameter of the opening portion 214 is decreased, so that the vaporized particles which ~~contributes~~ contribute to deposition on the bottom of the opening portion 214 gradually come to be limited to particles passing the center of the opening portion 214. As a result, a conical deposit is formed on the bottom of the opening portion 214 as shown in Fig. 23A, and the conical deposit made of molybdenum constitutes the electron emitting portion 215.

K4

Beginning on page 13, line 4:

According to a first aspect of the present invention for achieving the above object, there is provided a method for producing a cold cathode field emission display, to which the method for producing a cold cathode field emission device according to the first aspect of the present invention is applied. That is, it is a method which comprises arranging a substrate having an anode electrode and a phosphor layer and a support member having a cold cathode field emission device such that the phosphor layer or the anode electrode and the cold cathode field emission device face each other and ~~bonding~~ bond the substrate and the support member in their circumferential regions,

A5

Beginning on page 18, line 20:

A6

In the production method according to the second aspect of the present invention, from the viewpoints that the dissociation degree of a source gas used for the formation of the electron emitting portion is increased and that the conical electron emitting portion is reliably formed, preferably, the step of forming the conical electron emitting portion made of carbon is carried out on the basis of a plasma CVD method under a condition satisfying a plasma density of at least 1016m-3 (107mm-3), preferably at least 1017m-3 (108mm-3), more preferably at least 1019m-3 (1010mm-3) in a state where a bias voltage is applied to the support member. Otherwise, from the viewpoints that the dissociation degree of a source gas used for the formation of the electron emitting portion is increased and that the conical electron emitting portion is reliably formed, preferably, the step of forming the conical electron emitting portion made of carbon is carried out on the basis of a plasma CVD method under a condition satisfying an electron temperature of 1 to 15 eV, preferably 5 eV to 15 eV and an ion current density of 0.1 mA/cm2 to 30 mA/cm2, preferably, 5 mA/cm2 to 30 mA/cm2, in a state where a bias voltage is applied to the support member. In these cases, for satisfying the above conditions, the plasma CVD method is selected from an inductively coupled plasma CVD method, an electron cyclotron resonance plasma CVD method, a helicon wave plasma CVD method or a capacitively coupled plasma CVD method. In the step of forming the conical electron emitting portion made of carbon, the temperature for heating the support member can be set at 600 (C or lower, preferably at 500 (C or lower, more preferably at 400 (C or lower, still more preferably at 300 (C or lower. The temperature lower limit of heating the support member can be a temperature at which the conical electron emitting portion made of carbon can be formed.

Beginning on page 33, line 4:

A7

When no gate electrode is provided in the cold cathode field emission display of the present invention, the voltage to be applied to the cathode electrode is controlled pixel by pixel. In this case, the anode electrode may be formed to have a structure in which the effective ~~filed~~ field is covered with an electrically conductive material in the form of one sheet or a structure in which anode electrode units each of which corresponds to one or a plurality of electron emitting

portions or one or a plurality of pixels are formed together. When a voltage greater than the threshold voltage is applied to the cathode electrode, electrons are emitted from the electron emitting portion on the basis of a quantum tunnel effect under an electric field formed by the anode electrode, and the electrons are attracted toward the anode electrode to collide with the phosphor layer. The brightness is controlled by a voltage applied to the cathode electrode. Alternatively, there may be employed a constitution in which the cathode electrode is designed in the form of a stripe, the anode electrode is also designed in the form of a stripe, and the stripe-shaped cathode electrode and the stripe-shaped anode electrode are arranged such that the projection image of the cathode electrode and the projection image of the anode electrode cross each other at right angles. Electrons are emitted from the electron emitting portion positioned in an overlapped region of the projection image of the anode electrode and the projection image of the cathode electrode. A display having such a constitution is driven by a so-called simple matrix method. That is, a relatively negative voltage is applied to the cathode electrode, and a relatively positive voltage is applied to the anode electrode. As a result, electrons are emitted into the vacuum space selectively from the electron emitting portion in an anode electrode/cathode electrode overlapped region of a selected column of the cathode electrode and a selected row of the anode electrode (or a selected row of the cathode electrode and a selected column of the anode electrode), and the electrons are attracted toward the anode electrode and collide with the phosphor layer constituting the anode panel to excite the phosphor layer to emit light.

A7 cont.

Beginning on page 36, line 8:

A8

Figs. 10A, 10B, 10C and 10D are schematic partial plan views of <u>a</u> plurality of opening portions of the gate electrode in Example 2.

Beginning on page 49, line 9:

A9

A stripe-shaped material layer (metal foil) 113A having opening portions 114A as shown in the schematic partial plan view of Fig. 7 or Figs. 10A to 10D is prepared. And, in a state where the stripe-shaped material layer 113A is stretched such that it is in contact with the top

surfaces of the separation walls 12A and that the opening portions 114A are positioned over the electron emitting portions 15, the stripe-shaped material layer 113A is fixed to the top surfaces of the separation walls 12A with a thermosetting adhesive (for example, epoxy adhesive) (see Fig. 6C), whereby the gate electrode 113 can be formed over the electron emitting portion 15. Alternatively, as shown in the schematic partial cross-sectional view of a vicinity of end portion of the support member 10 in Fig. 8, there may be employed a structure in which both ends of the stripe-shaped material layer 113A ~~is~~ are fixed to the vicinities of the support member 10. More specifically, for example, projection portions 116 are formed beforehand in circumferential portions of the support member 10, and thin layers 117 made of the same material as that of the stripe-shaped material layer 113A are formed on the top surfaces of the projection portions 116 in advance. And, in a state in which the stripe-shaped material layer 113A is stretched, it is welded to the thin layers 117 with a laser, whereby the gate electrode 113 having the opening portions 114A can be formed over the electron emitting portions 15. The projection portions 116 can be formed, for example, simultaneously with the formation of the separation walls 12A. The above stripe-shaped material layer 113A is fixed such that the projection image of the stripe-shaped material layer 113A and the projection image of the cathode electrode 11 cross each other at right angles.

A9 Cont.

Beginning on page 58, line 14:

A10

~~An~~A variant of Example 1 ~~variant~~ having a constitution of the stripe-shaped cathode electrode and the stripe-shaped anode electrode can be applied to Example 5.

Beginning on page 68, line 11:

A11

While the present invention has been explained with reference to Examples hereinabove, the present invention shall not be limited thereto. Specific structures of the electron-emitting devices, the cold cathode field emission devices and the cold cathode field emission displays, production conditions thereof and materials used ~~therefor~~ therefore are all given for explanatory purposes and may be altered as required. In the Examples, the nickel layer formed by a sputtering method is used for the cathode electrode or for the electron-emitting-portion-forming

layer. However, the cathode electrode or the electron-emitting-portion-forming layer shall not be limited thereto, and any metal may be used so long as it has catalytic activity in an atmosphere employed for forming (synthesizing) the electron emitting portions. Further, the sputtering method may be replaced with a physical vapor deposition method (for example, an electron beam heating method or a vacuum vapor deposition method) or a plating method (for example, a plating method using a zinc plating solution or a tin plating solution). When the plating method is used, the formation of the electron-emitting-portion-forming layer on the gate electrode can be prevented by connecting the gate electrode to an anode electrode side. For forming the electron emitting portions made of carbon, the helicon CVD method may be replaced with an inductively coupled plasma CVD method, an electron cyclotron resonance plasma CVD method, or a capacitively coupled plasma CVD method.

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